Docket No. 520.43328X00
Appln. No. 10/733,385
September 27, 2005

REMARKS

Applicants have amended the title of the above-identified application consistent with the title suggested by the Examiner in Item 5 on page 2 of the Office Action mailed June 27, 2005. The Examiner is thanked for the suggested new title. In view of the presently submitted new title, the requirement for a new title has been satisfied.

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended each of independent claims 1, 3 and 7 to recite a "metal" catalytic component. In addition, Applicants have amended claims 1 and 7 to recite that the catalyst carrier contains carbon, and have amended claims 1 and 3 to recite that the catalyst carrier contains atoms that have formed covalent bonds with the metal catalytic component. In light of amendments to independent claims 1, 3 and 7, claim 2 has been cancelled without prejudice or disclaimer, and claims 4-6 have been amended.

In addition, Applicants are adding new claims 12-28 to the application. Claim 12, dependent on claim 7, recites that the at least one member has formed covalent bonds with the metal catalytic component. Claims 13, 20 and 25, dependent respectively on claims 1, 3 and 7, recite that the atoms that have formed covalent bonds with the metal catalytic component (or with the at least one member) is chemically bonded to the carbon; and claims 14, 21 and 23, dependent respectively on claims 1, 3 and 7, recite that the carbon is amorphous or crystalline. Claims 15-17, dependent respectively on claims 1, 15 and 16, respectively recites that the atoms that have formed covalent bonds with the metal catalytic component are nitrogen atoms, recites that the nitrogen atoms are located on the surface of the catalyst carrier, and recites a density of

nitrogen atoms on the surface of the catalyst carrier. Claims 18 and 19, dependent respectively on claims 1 and 18, respectively recites that the atoms that have formed covalent bonds with the metal catalytic component are located on the surface of the catalyst carrier, and recite a density of these atoms, forming covalent bonds, on the surface of the catalyst carrier. Claim 22 recites the same subject matter as claim 18, but is dependent on claim 3; and claim 24, dependent on claim 7, recites that the at least one member is located on the surface of the catalyst carrier. Claims 26-28, dependent respectively on claims 1, 3 and 7, recite that the carbon material is selected from a specific group of carbon materials.

In connection with the presently amended claims, see, e.g., pages 4-6, 9, 11-13, 15-19 and 25-27, of Applicants' specification.

The rejection of claims 1-6 under the first paragraph of 35 USC 112, as being based on a disclosure which is not enabling, set forth in Item 6 on page 3 of the Office Action mailed June 27, 2005, is noted. In connection therewith, the Examiner contends that the covalent bond is critical or essential to the practice of the present invention, but is not included in the previously considered claims, the Examiner contending that the previously considered claims do not clearly require covalent bonding but only that the materials for the catalytic material and catalyst carrier are such that they can covalently bond. Claims 1 and 3 have been amended to recite atoms "that have formed covalent bonds with said metal catalytic component". In view of amendments to the claims 1 and 3, it is respectfully submitted that the rejection under the first paragraph of 35 USC 112 is moot.

Applicants respectfully submit that all of the claims presented for consideration

by the Examiner patentably distinguish over the teachings of prior art applied by the Examiner in rejecting claims in the Office Action mailed June 27, 2005, that is, the teachings of U.S. Patent No. 6,380,126 to Finkelshtain, et al., and United States Patent Application Publication No. U.S. 2002/0127440 to Yamamoto, et al., under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such catalytic material as in the present claims, including the metal catalytic component and the catalyst carrier which contains, inter alia, carbon, the catalytic material also containing atoms that have formed covalent bonds with the metal catalytic component. See claim 1; note also claim 3.

In addition, it is respectfully submitted that these references would have neither taught nor would have suggested such catalytic material as in the present claims, including the metal catalytic component and catalyst carrier comprising carbon, and wherein the catalyst carrier has a structure in which part of the carbon atoms is replaced with the atoms that have formed covalent bonds with the metal catalytic component. See claim 3.

Moreover, it is respectfully submitted that the applied references would have neither disclosed nor would have suggested such catalytic material as in the present claims, including the metal catalytic component, and wherein the catalyst carrier for supporting the metal catalytic component contains carbon and at least one member selected from the group consisting of nitrogen atoms, oxygen atoms, phosphorous atoms and sulfur atoms. See claim 7.

Furthermore, it is respectfully submitted that these applied references would have neither taught nor would have suggested such catalytic material as in the present claims, having features as discussed previously in connection with claims 1, 3 and 7, and, moreover, wherein the at least one member selected from the group specified in claim 7 has formed covalent bonds with the metal catalytic component (see claim 12); and/or wherein the atoms that have formed covalent bonds with the metal catalytic component are nitrogen atoms (see claim 15), and/or wherein these nitrogen atoms (or the atoms that have formed covalent bonds with the metal catalytic component) are located on the surface of the catalyst carrier (see, e.g., claims 16, 18, 22 and 24), more specifically, the density of the nitrogen atoms (atoms forming covalent bonds with the metal catalytic component) on the surface, as in claims 17 and 19; and/or wherein the atoms that have formed covalent bonds with the metal catalytic component (or the at least one member) are chemically bonded to the carbon (see claims 13, 20 and 25); and/or wherein the carbon is amorphous or crystalline (see claims 14, 21 and 23).

The invention as claimed in the above-identified application relates to a catalytic material, useful, for example, in fuel cells such as solid-state polymer electrolyte fuel cells and direct methanol fuel cells. As described in the first full paragraph on page 2 of Applicants' specification, catalytic materials used for the electrodes and other components of these fuel cells generally take a configuration in which catalysts are dispersed on catalyst carriers. However, the activity of catalytic materials greatly depends on the particle sizes of the catalytic components, and decreases as the active area decreases.

In conventional catalytic materials, since respective metal catalytic components

are supported on catalyst carriers mainly by physical adsorption, particles of these metal catalytic components cohere or grow during the preparation of the catalytic materials; and, consequently, particles of the metal catalytic component increase in size to decrease specific surface area and thus decrease the activity of the catalyst.

Against this background, Applicants provide a catalytic material which can easily and effectively be provided, at relatively low cost using available materials, yet which does not have reduced catalyst component active area with resulting reduced activity. Applicants have found that particles of a metal catalytic component can be prevented from cohesion by forming covalent bonds between the metal catalytic component and atoms in the catalyst carrier, and that through use of carbon as the catalyst carrier an effective catalytic material can be achieved from known materials, easily and effectively. Furthermore, since coherence of particles of the metal catalytic component can be avoided, amount of catalyst carrier can be reduced when the same amount of catalytic component is included in an electrode; and the fact that the amount of catalyst carrier can be reduced means that given the same electrode area, the thickness of the electrode can be reduced; and diffusion of a fuel in the electrode, conductivity of electrons and conductivity of protons can be improved. In addition, output density can also be improved. Note, in particular, the paragraph bridging pages 11-13 of Applicants' specification.

Yamamoto, et al. discloses a polymer electrolyte fuel cell, wherein the material for fuel is decomposed by a biochemical catalyst to generate hydrogen as fuel. See paragraph [0003] on page 1 of this patent document. Thus, this patent document discloses that oxygen-containing hydrocarbon is passed through a layer containing a

biochemical catalyst comprised of a hydrogen-generative anaerobic bacterium, a hydrogen-generative yeast, a hydrogen-generative enzyme and/or the like and thereby the oxygen-containing hydrocarbon is decomposed to produce hydrogen, which is supplied as fuel to the anode of the polymer electrolyte fuel cell. Note paragraphs [0018] and [0019] on page 2 of this published patent document. Note also a further description of the biochemical catalyst, in paragraphs [0029] and [0032] on page 3 of this published application. Note especially the description in paragraph [0032], disclosing that the biochemical catalyst is fixed onto a layer of a porous material such as carbon black, acetyl cellulose, collagen-polyvinyl alcohol, zeolite, as well as others, and that as techniques for fixing the biochemical catalyst there may be mentioned the technique of covalent-bonding the biochemical catalyst to a fixation carrier, the technique of binding the biochemical catalyst by adsorption, an envelope fixation technique of enveloping the biochemical catalyst with a polymeric substance, and other techniques. Note also paragraph [0028] on page 3 of this published application, disclosing an electrocatalyst attached to electrodes.

It is emphasized that Yamamoto, et al. discloses fixing a biochemical catalyst to various layers using techniques including, inter alia, covalent-bonding the biochemical catalyst to a fixation carrier. It is respectfully submitted that this reference does not disclose, nor would have suggested, such catalytic material as in the present claims, including the metal catalytic component.

The contention by the Examiner that in Yamamoto, et al., having the catalyst material covalently bonded, the "catalytic component can be platinum", is respectfully traversed. It is respectfully submitted that Yamamoto, et al. discloses a biochemical

catalyst, described in paragraph [0018] in this published patent application, as covalently bonded to a fixation carrier. Yamamoto, et al. discloses that where the electrode catalyst is disclosed, it is described that a mixture of fine particles of platinum and ruthenium, as it is or carried on a carbon having a large surface area, is mixed and provided using a specified technique. Note paragraph [0028] of the published patent application. Considering the teachings of Yamamoto, et al. as a whole, it is respectfully submitted that Yamamoto, et al. would have taught away from the presently claimed subject matter, with covalent bonding of the metal catalytic component.

Finkelshtain, et al. discloses electrocatalysts based on highly electroconducting polymers that have transition metal atoms covalently bonded to backbone hetero atoms. See column 1, lines 7-12. Note also column 3, lines 36-40. Various highly electrically conductive polymers are described, for example, at column 2, lines 60-66, and column 4, lines 15-17; and preferred transition metals are described, for example, in column 4, lines 17-20. Note also column 5, lines 9-12.

It is respectfully submitted that Finkelshtain, et al. would have neither taught nor would have suggested the presently claimed catalytic material, including, inter alia, wherein the catalyst carrier contains carbon, in particular, wherein the carbon is amorphous or crystalline; and, more particularly, wherein the carbon is carbon material selected from the group consisting of carbon black, graphite, carbon nanofibers and carbon nanotubes.

In particular, note the definition of "carbon" on page 4, lines 10-12 of Applicants' specification. It is respectfully submitted that these materials are much different from the highly electroconductive polymer (e.g., polyaniline, polypyrrole, polythiophene

and/or polyfaran) disclosed in Finkelshtain, et al. It is respectfully submitted that Finkelshtain, et al. would have neither taught nor would have suggested the catalytic material as in the present claims, including, inter alia, the catalyst carrier containing carbon.

Reference by the Examiner to paragraph [0032] in Finkelshtain, et al., as support for the catalyst carrier containing carbon (see line 4 on page 4 of the Office Action mailed June 27, 2005), is noted. It is respectfully submitted that there is no paragraph numbered [0032] in Finkelshtain, et al. The Examiner is respectfully requested to point out the specific portion of Finkelshtain, et al. supporting a catalyst carrier containing carbon, as in the present claims.

The provisional obviousness-type double patenting rejection over claims of copending Application No. 11/062,597, set forth in Items 9 and 10 on pages 4-6 of the Office Action mailed June 27, 2005, is noted. The Examiner has indicated that the provisional double patenting rejections can be overcome by the filing of a Terminal Disclaimer. Enclosed herewith please find a Terminal Disclaimer for the above-identified application, with respect to any U.S. patent issuing from Application No. 11/062,597. In view of this Terminal Disclaimer, it is respectfully submitted that the provisional obviousness-type double patenting rejections are moot.

The enclosed Terminal Disclaimer is being submitted so as to facilitate proceedings in connection with the above-identified application. It is respectfully submitted that the present submission of this Terminal Disclaimer does not constitute an admission as to the propriety of, or agreement with, the provisional double patenting rejection; and does not constitute an admission as to the propriety of, or agreement

with, arguments made by the Examiner in connection with the double patenting rejection.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently pending in the application are respectfully requested.

Applicants request any shortage of fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 520.43328X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

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